IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

MANZ et al — Atty. Ref.: 550-308

Serial No. 10/046,564 — Group: 1723

Filed: January 16, 2002 — Examiner: E. Therkorn

For: FLUID TRANSPORT APPARATUS AND METHOD

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APPEAL BRIEF

On Appeal From Group Art Unit 1723

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APPEAL BRIEF

Sir:

I. REAL PARTY IN INTEREST

The real party in interest in the above-identified appeal is the Imperial College of Science, Technology and Medicine in London, England, by virtue of the Assignment from the inventors to the Imperial College recorded March 27, 2002, at Reel 12730, Frame 0269.

II. RELATED APPEALS AND INTERFERENCES

There are believed to be no related appeals or interferences with respect to the present application and appeal.

III. STATUS OF CLAIMS

Claims 1 and 3-20 stand rejected in the outstanding Final Rejection. After admitting that an interview conducted November 17, 2003 "resulted in the allowance of the application" (as reported in the Interview Summary Record attached to paper no. 11252003), Examiner indicated in the Final Rejection that claims 1, 3-20, 22 and 23 are rejected as unpatentable under 35 USC §103 over the cited prior art.

IV. STATUS OF AMENDMENTS

An Amendment under Rule 116 was submitted on January 28, 2004 implementing the agreement reached initially on November 17, 2003 and again on December 2, 2003 during telephone interviews with the Examiner. The agreement in the November 17, 2003 interview, as set out in the "Examiner-Initiated Interview Summary" attached to Paper No. 11252003, involved the Examiner's indication that if claims 22 and 23 were cancelled, the application would otherwise be in condition for allowance.

Appellants were unable to obtain the assignee's approval for cancellation of these claims until December 2, 2003, at which time a further telephone interview was conducted with the Examiner. Appellants authorized the cancellation of claims 22 and 23 whereupon the Examiner indicated that he had just prepared a further Official Action and would be mailing that Official Action shortly.

Apparently this Official Action was the subsequently received Final Rejection also dated December 2, 2003. Surprisingly, the Final Rejection did not include an allowance of claims 1 and 3-20 along with a rejection of claims 22 and 23. While the Rule 116 Amendment implements the oral cancellation of claims 22 and 23 made during the telephone interview on December 2, 2003, the Examiner's failure to implement the agreement is noted.

V. SUMMARY OF THE INVENTION

The present invention relates to a micro-fabricated chromatographic system including an apparatus for transporting fluid between a fluid inlet through a separation channel to a fluid outlet in order to implement a chromatographic analysis of the fluid.

In the past, chromatographic systems were well known but generally somewhat bulky and complex. As noted in the Henderson et al reference (U.S. Patent 6,258,263), it is desirable to be able to locate miniaturized chromatographs on a chip fabricated through microelectromechanical techniques. However, in such systems there is the further complication in that the fluid to be analyzed must be moved through the separation columns.

Henderson avoids the problem of how to transport very small quantities of fluid for analysis by requiring that the inlet to the chromatograph system be connected to "an external pumping system (not shown) used for transporting

carrier and sample into the inlet port 28" (column 8, lines 38-40). Thus, Henderson, while teaching the desirability of a liquid chromatograph on a chip, does not address the problem of how to transport the fluid and instead requires some undisclosed external pumping system to transport the carrier and sample into the inlet port of the chromatograph.

The necessity to connect the chromatograph on a chip to external pumps in order to move fluid through the sensing portions of the chip causes further problems. It is desirable to have the entire system located on a chip, i.e., the chromatographic system including the pumping mechanism for moving fluid through the chromatograph.

Appellants of the present invention have solved the problem associated with prior art chip liquid chromatographs by utilizing capillary and evaporative forces to promote flow of the liquid through the chromatograph. Appellants provide a fluid inlet and the necessary separation channel for accomplishing the chromatographic functions. At least one evaporator channel is responsive to the fluid and has a fluid outlet for evaporating the fluid. Evaporation of the fluid and the resultant capillary action to replace evaporated fluid serves to move fluid from the inlet and through the separation channel.

Accordingly, the presently claimed invention is comprised of a transport channel including at least one fluid inlet and a separation channel and "**an evaporator including at least one evaporator channel arranged to receive**

fluid" and "**at least one open fluid outlet operable to evaporate fluid**" so as "**to cause the flow of fluid through the transport channel**."

VI. ISSUES

Whether claims 1, 5 and 7-19 are obvious under 35 USC §103 over Henderson (U.S. Patent 6,258,263) in view of Miyazaki (EP 0 568 024).

Whether claims 3 and 4 are obvious under 35 USC §103 as unpatentable over Henderson in view of Miyazaki and further in view of Zare (U.S. Patent 6,136,187).

Whether claim 6 is unpatentable under 35 USC §103 over Henderson in view of Miyazaki and further in view of Sutton (U.S. Patent 6,103,112) or Overton (U.S. Patent 6,068,684).

Whether claim 20 is unpatentable under 35 USC §103 over Henderson in view of Miyazaki and further in view of Hatch (U.S. Patent 6,238,565).

VII. GROUPING OF CLAIMS

The rejected claims stand or fall as being dependent from independent claim 1 and are patentable as described in the argument portion of this Appeal Brief.

VIII. ARGUMENT

1. Discussion of the References

Henderson et al (U.S. Patent 6,258,263), as discussed above, teaches a microelectromechanical fabricated chromatograph system in which a liquid chromatograph is provided on a chip. Henderson specifically requires "an external pumping system (not shown) used for transporting carrier and sample into the inlet port 28 and subsequently through the fingers 32 and micro-channels 18 of the chromatograph 10." Henderson contains no teaching as to what might comprise a suitable pumping system.

There is no realization in Henderson that there is any difficulty or inconvenience in requiring connection to "external pumping systems." Apparently there is no recognition in Henderson of any advantage to be achieved by including an internal pumping system, especially one utilizing a transport channel and an evaporator channel as disclosed in Appellants' invention. Henderson clearly fails to recognize the problem of external pumping systems solved by Appellants' invention and certainly contains no teaching of any use of at least one evaporator channel.

Miyazaki (EP 0 568 024 A2) teaches a method for moving liquid. Specifically, Miyazaki teaches that a liquid reservoir portion 2 is required in order to establish hydrostatic pressure on the liquid. Miyazaki then requires that "the

resistance in the flow path 1 and the surface tension of the surface of liquid exposed outwardly of the opening portion 3 are balanced with the pressure by the liquid level in the liquid reservoir portion 2 and the flow is stationary." (Column 3, lines 16-21).

The Miyazaki teaching is analogous to the conventional hummingbird feeders in which sugar water in a reservoir leads through a narrow pipette to an orifice. Surface tension on the sugar water at the orifice prevents the reservoir from being emptied by gravitational forces. As the hummingbirds drink, the surface tension is disturbed allowing the sugar water to flow under gravitational pull, but as soon as the drinking stops, the surface tension prevents further flow.

In other words, the Miyazaki reference does not use fluid evaporation to cause the flow of the fluid through the transport channel, but rather uses "the pressure by the liquid level in the liquid reservoir portion 2" to replenish liquid which is evaporated or boiled away. Thus, there is no teaching in Miyazaki of any use of evaporation of fluid to "cause the flow of fluid through the transport channel."

Additionally, Miyazaki fails to recognize any difficulty or problem in terms of moving fluid for a liquid chromatograph located on a chip or any suggestion for combining the pressure fed evaporator technique with such a chromatograph.

Zare et al (U.S. Patent 6,136,187) contains a disclosure of a separation column containing a porous matrix and a method of packing the column in

conjunction with a chromatograph. The Zare reference has nothing to do with a micro-fabricated chromatographic system as is evident by reference to Figure 1 in which the end portion of a syringe needle 11 is located between the plates of the separation column 12. Clearly Zare has nothing to do with a micro-fabricated chromatographic system, nor is there disclosed any evaporative method to pass liquid through any resultant chromatograph.

Zare is cited as teaching reducing gas pressure to accelerate evaporation, but does not address the problem of evaporation induced fluid movement or the treatment of an evaporative surface so as to control fluid movement towards an evaporator channel. There is clearly no recognition in Zare of combining a chromatograph with evaporation induced liquid flow in order to provide a micro-fabricated chromatograph.

Sutton et al (U.S. Patent 6,103,112) is cited by the Examiner as teaching the use of a Peltier heater/cooler for air circulating around a chromatographic apparatus. While this is discussed in conjunction with Figure 8 (see column 13, lines 20-25), there is no disclosure that this is with respect to an evaporator, especially where the evaporator is the cause of "flow of fluid through the transport channel" as in Appellants' independent claim 1 and claim 6 dependent thereon.

There is no recognition that evaporation alone can induce flow through a transport channel as set out in Appellants' claimed micro-fabricated chromatographic system.

Overton (U.S. Patent 6,068,684) also teaches a microstructure comprised as a chromatograph with rectangular columns. As alleged by the Examiner, Overton teaches the use of a Peltier cooler as a temperature control means.

There is no disclosure of any problem associated with fluid transport in a chromatographic system or the use of temperature control of an evaporator channel to control fluid flow through such a system.

Hatch (U.S. Patent 6,238,565) discloses a "monolithic matrix" for separating bio-organic molecules, as suggested by the Examiner. However, there is no recognition in Hatch of any problem associated with fluid transport through a chromatographic apparatus or the use of fluid evaporation to move fluid through a separation channel in a micro-fabricated chromatographic system.

2. Discussion of the Rejections

Claims 1, 5 and 7-19 stand rejected under 35 USC §103 as unpatentable over Henderson in view of Miyazaki. To the extent it is understood, the Examiner admits that Henderson fails to teach Appellants' claimed fluid evaporation pump, but apparently believes that Miyazaki discloses such a pump. The Examiner does not actually allege that Miyazaki teaches an evaporation propelled fluid transport system, but argues advantages of the Miyazaki system which would also be advantages of Appellants' claimed system.

Claims 3 and 4 stand rejected under 35 USC §103 as unpatentable over the Henderson/Miyazaki combination further in view of Zare. The Examiner is apparently of the belief that Zare is related to a micro-fabricated chromatographic system and somehow discloses a reduction in gas pressure to aid evaporation.

Claim 6 stands rejected under 35 USC §103 as unpatentable over the Henderson/Miyazaki combination as previously applied and further in view of either Sutton or Overton. To the extent the rejection is understood, the Examiner apparently believes that both Sutton and Overton in teaching the maintaining of temperatures suggest the controlling of temperature at the "at least one fluid outlet" recited in Appellants' independent claim 1 and dependent claim 6.

Claim 20 stands rejected under 35 USC §103 as unpatentable over the Henderson/Miyazaki combination as previously applied and further in view of Hatch. Again, to the extent it is understood, the Examiner apparently believes that Hatch in teaching a monolithic matrix renders obvious the combination of such a matrix with the Henderson/Miyazaki combination.

3. The Errors in the Final Rejection

There are at least three significant errors in the Final Rejection and they are summarized as follows:

(a) No prior art reference teaches any of the claimed structure for causing "the flow of fluid through the transport channel" by means of an evaporator;

(b) The Examiner fails to provide any reason or motivation for combining the Henderson and Miyazaki references; and

(c) The Henderson and Miyazaki references both teach away from any combination.

(a) No prior art reference teaches any of the claimed structure for causing "the flow of fluid through the transport channel" by means of an evaporator

In the outstanding Official Action, the Examiner admits that "the claims differ from Henderson . . . in reciting the particular micropump." This admission that Henderson fails to teach the subject matter of Appellants' independent claim 1 is appreciated. Appellants' claim 1 specifies "an evaporator . . . having at least one open fluid outlet operable to evaporate fluid . . . to cause the flow of fluid through the transport channel." In order to render obvious the above-recited structure and structural interrelationship, it is necessary that the Examiner identify how or why he believes the Miyazaki reference teaches the recited structure.

As pointed out above, Miyazaki, at column 3, lines 15-21, clearly teaches that it is the hydrostatic pressure caused by the liquid level in the reservoir portion which causes flow through the flow path and not evaporation from at least one

fluid outlet. Without any hydrostatic pressure in the liquid reservoir portion 2, no amount of evaporation will cause any flow of fluid through the chromatograph in the Miyazaki reference.

Therefore, Miyazaki fails to teach the structure and structural interrelationship specifically set out in Appellants' independent claim 1 and all claims dependent thereon (including claims 1, 5 and 7-19). As a result, even if the Henderson and Miyazaki references were combined, they fail to teach the subject matter of Appellants' independent claim 1 and claims dependent thereon.

Moreover, it is noted that Examiner Therkorn contacted Appellants' undersigned representative on May 13, 2003 indicating that if in claim 1 the preamble was amended to read "a micro-fabricated chromatographic system" he believed that limitation would define over EP 0 568 024. It is noted that Appellants subsequently amended claim 1 to include the language proposed by the Examiner, and notwithstanding the previous agreement, the Examiner continues to recite the Miyazaki reference in the rejection of claim 1.

The Court of Appeals for the Federal Circuit has continually held that "the PTO has the burden under §103 to establish a *prima facie* case of obviousness." *In re Fine*, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). The Court held that the PTO "can satisfy this burden only by showing some objective teaching in the prior art . . . ." Here, the Examiner has clearly failed to show any teaching in Miyazaki

or any other reference to indicate that evaporation can cause the flow of fluid through the transport channel as claimed.

Accordingly, there is no basis for any rejection of claim 1 or any claim dependent thereon based upon the Henderson/Miyazaki combination.

(b) The Examiner fails to provide any reason or motivation for combining the Henderson and Miyazaki references

The Court of Appeals for the Federal Circuit has also consistently held that

> "to prevent the use of hindsight based on the invention to defeat patentability of the invention, this court **requires the examiner to show a motivation** to combine the references that create the case of obviousness. In other words, **the Examiner must show reasons** that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed." (emphasis added).

In re Rouffet, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998).

As noted above, neither the Henderson nor Miyazaki reference contain any recognition of the problem solved by the present invention, i.e., the generation of the very small pressures needed to move extremely small amounts of fluid through capillary channels in a micro-fabricated chromatographic system. Henderson teaches the necessity of a separate pump and Miyazaki teaches that the use of the pressure of the liquid level in a liquid reservoir portion 2 are sufficient to move liquids. However, there is no recognition by Miyazaki or Henderson that the smaller micro-fabricated chromatographic system requires significantly less

pressure and that such pressure can be generated by fluid evaporation from capillary systems.

The Examiner has failed to meet his burden of establishing how or why Henderson or Miyazaki would even be aware of the problem solved by Appellants' invention or that it would be obvious for one of ordinary skill in the art to combine the elements from Henderson and Miyazaki, assuming that they can even be combined. The Examiner has simply failed to meet his burden of establishing a *prima facie* case of obviousness under 35 USC §103.

(c) The Henderson and Miyazaki references both teach away from any combination

The Court of Appeals for the Federal Circuit has also held that it is "error to find obviousness where references 'diverge from and teach away from the invention at hand'." *In re Fine* at 1599.

The Henderson reference teaches away from Appellants' evaporative pump by suggesting that the Henderson inlet port "is operatively connected to an external pumping system (not shown)." (Column 8, lines 38 and 39). Thus, Henderson teaches that an external pump is needed for its operation.

Miyazaki teaches away from Appellants' claimed evaporative pump by suggesting that a hydrostatic pressure pump is to be used. Specifically, Miyazaki requires that "resistance in the flow path and the surface tension of the surface of liquid exposed outwardly of the opening portion are balanced with the pressure by

the liquid level in the liquid reservoir portion 2 and the flow is stationary." (Column 3, lines 16-21). Only when the liquid is boiled off does the pressure in the liquid reservoir portion 2 overcome the resistence to fluid flow and move fluid to the opening portion. Notwithstanding that Miyazaki also suggests that "the liquid corresponding to the gasified amount is supplied by capillary phenomenon," it is clear that it is hydrostatic pressure moving the liquid and not evaporative pressure.

Thus, Henderson requires an external pump and Miyazaki teaches a hydrostatic pressure pump. Both references teach away from Appellants' claimed structure, i.e., evaporative pressure causing "the flow of fluid through the transport channel." As a result, both Henderson and Miyazaki teach away from Appellants' claimed combination of elements.

IX. CONCLUSION

It is clear from the above discussion that no reference teaches Appellants' claimed organization of structures such that evaporation of fluid causes "the flow of fluid through the transport channel." Henderson clearly requires an external pump and Miyazaki clearly requires hydrostatic pressure from the "liquid reservoir portion 2." Additionally, neither reference is directed to solving the problem solved by Appellants' invention, and thus there is no reason to combine those

references. In fact, both references teach away from Appellants' claimed combination.

Thus, and in view of the above, the rejection of claims 1 and 3-20 over the cited prior art is clearly in error and reversal thereof by this Honorable Board is respectfully requested.

Respectfully submitted,

NIXON & VANDERHYE P.C.

By: _____

Stanley C. Spooner
Reg. No. 27,393

SCS:kmm
Enclosures
Appendix A - Claims on Appeal

APPENDIX A

Claims on Appeal

1. A micro-fabricated chromatographic system, said system comprising:

a transport channel including at least one fluid inlet and a separation channel; and

an evaporator including at least one evaporator channel arranged to receive fluid, each evaporator channel having at least one open fluid outlet operable to evaporate fluid at the at least one fluid outlet so as to cause the flow of fluid through the transport channel.

3. The system as claimed in claim 1, wherein the evaporator includes a gas conditioner for conditioning the gas at the at least one fluid outlet.

4. The system as claimed in claim 3, wherein the gas conditioner comprises a gas flow unit for maintaining a gas flow over the at least one fluid outlet.

5. The system as claimed in claim 1, wherein the evaporator includes a heater for raising the temperature at the at least one fluid outlet.

6. The system as claimed in claim 1, wherein the evaporator includes a cooler for controlling the temperature at the at least one fluid outlet.

7. The system as claimed in claim 1, wherein the evaporator includes a plurality of fluid outlets.

8. The system as claimed in claim 1, wherein at least one of the at least one channel of the evaporator is branched.

9. The system as claimed in claim 1, wherein the evaporator includes a plurality of channels.

10. The system as claimed in claim 1, wherein the transport channel has a width of less than 20 micrometers.

11. The system as claimed in claim 1, wherein the transport channel has a depth of less than 20 micrometers.

12. The system as claimed in claim 1, wherein the fluid transport system acts on a fluid comprising an operating fluid.

13. The system as claimed in claim 12, wherein the operating fluid comprises water.

14. The system as claimed in claim 12, wherein the operating fluid comprises acetonitrile, methanol, standard mixtures for chromatographic systems or organic solvents.

15. The system as claimed in claim 1 comprising two plates between which said transport channel and said evaporator channel are formed.

16. The system as claimed in claim 15, wherein at least one of said plates is formed of one of glass silicon, poly-di-methyl-siloxane and other polymeric material.

17. A high pressure liquid chromatography (HPLC) apparatus comprises the transport system of claim 1.

18. The high pressure liquid chromatography (HPLC) apparatus of claim 17, wherein the HPLC apparatus is an open tubular HPLC system.

19. The high pressure liquid chromatography (HPLC) apparatus of claim 17, wherein the HPLC apparatus contains a packed bed.

20. *(Original)* The high pressure liquid chromatography (HPLC) apparatus of claim 17, wherein the HPLC apparatus contains a porous monolith.